

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Biofuels have become a promising alternative fuel because of their possible environmental benefits and the current concern over the depletion of fossil fuel sources. Biofuels include gaseous fuels and liquid fuels, and usually produced from renewable resources (Ong and Bhatia, 2010). Gaseous biofuels such as methane and hydrogen, as well as liquid biofuels such as biogasoline and biodiesel are primarily used by vehicles. In addition, they are also used for the production of electricity (Ong and Bhatia, 2010). Biofuels can be produced from plant oil based feed stock (vegetable oils and palm oil), waste materials (agriculture, wood, and crop residue), aquatic biomass (algae, and water weed), energy crops (sugar, barley, wheat, etc., containing starch) and forest products (trees, shrubs and wood) (Ong and Bhatia, 2010; Taufiqurrahmi and Bhatia, 2011; Twaiq et al, 2004; Venderbosch and Prins, 2010; Wang et al., 2015).

Besides, biofuels produced from vegetable oils is considered “ CO_2 neutral” since they are from plant sources which remove CO_2 from the atmosphere, and release the same amount when it burnt. Vegetable oils are the most common feed stocks and are converted into liquid fuels due to their high energy capacity, natural liquid-phase material and availability as a renewable feedstock (Taufiqurrahmi and Bhatia, 2011). The use of non-edible plant oils is very important due to the tremendous demand for edible oils as food source. Furthermore, edible oils’ feedstock costs are far expensive to be used as fuel (Atabani et al., 2012).

The composition of oil determines the properties of the biofuel obtained. Several types of edible vegetable oils, as well as nonedible oil with a different composition in fatty acids, are consumed for the production of biofuel. However, the direct conversion of edible oil to fuel may not be economically feasible, even though the results have shown its potential

in obtaining liquid hydrocarbons. This is because, continuous and large-scale production of biofuel from edible oil without appropriate planning could cause negative impact on the food supply chain, causing further economic problems. A potential solution to overcome this problem is to utilize waste used cooking oil or non-edible oil (Gui et al., 2008).

Plant oil based feed stock mainly contains triglycerides, which can be easily reformed into liquid biofuels compared to other available biomass containing cellulose and starch (Mushtaq et al., 2016). *Hevea brasiliensis* tree, referred to Rubber tree, belongs to the family Euphorbiaceae (Kumar et al., 2011). It is available mainly in Indonesia, Malaysia, Liberia, India, Sri Lanka, Sarawak, and Thailand. Rubber seed oil is one of the non-edible vegetable oil, which contains 50–60 wt% oil and is considered a promising feedstock for biogasoline production (Ramadhas et al., 2004).

Catalytic cracking is one of the most efficient methods to produce biofuel, especially biogasoline, by cracking of vegetable oil in the presence of suitable catalyst. The catalytic cracking of edible and non-edible oils requires the development of proper cracking catalysts and reactors for the production of biogasoline (Taufiqurrahmi and Bhatia, 2011). The yield of hydrocarbons in catalytic cracking depends on the choice of shape selective catalyst, as well as acidity of the catalyst. In the cracking of vegetable oil, a microporous catalyst is preferred since selectivity of biofuel products such as the gasoline and diesel fractions is produced through the small pores of the catalyst. Besides, zeolites have excellent properties, in terms of high acidity, high thermal stability and excellent selectivity for gasoline production (Taufiqurrahmi and Bhatia, 2011).

1.2 Motivation

In the range of microporous zeolites, the medium pore zeolite catalysts are more effective in the aromatization of the intermediate olefin products compared to those with large pore zeolites. The conversion of canola oil and the overall yield of hydrocarbons decreased as the pore size of catalyst were increased. Also, the medium pore zeolite catalysts are more effective in the aromatization of the intermediate olefin products compared to the large pore zeolites (Katikaneni et al., 1995).

The medium pore size zeolite ZSM-5 gave the best performance among three zeolite catalysts tested in terms of conversion, gasoline and benzene, toluene, and xylene as aromatics yield (Katikaneni et al., 1995). Microporous catalysts such as zeolites, ZSM-5 have shown great potential as cracking catalysts (Taufiqurrahmi and Bhatia, 2011).

1.3 Problem Statement

Based on previous researches, the operating variables affecting cracking activity were feed/catalyst ratio, reaction temperature and weight hour space velocity. A higher reaction temperature and low feed rate gave a higher yield of gaseous product, while at a low reaction temperature and high feed rate deactivated the catalyst faster. The gasoline fraction was one of the desired products, and the optimum operating conditions were determined to maximize its yield (Ooi et al., 2004). This research aims to determine the optimum of feed to catalyst ratio in order to achieve high yield of biogasoline from rubber seed oil.

1.4 Objectives

The following is the objective of this research:

- 1) To determine the optimum amount of catalyst (ZSM-5) in fluid catalytic cracking process of biogasoline synthesis from rubber seed oil.
- 2) To determine the yield of biogasoline and correlate the yield and conversion kinetics with amount of catalyst used.
- 3) To optimize the temperature of fluid catalytic cracking of RSO for biogasoline synthesis with effects of residence time of reaction.